

NOTES ON CALYPTROBOTHRIUM, A CESTODE GENUS  
FOUND IN THE TORPEDO.

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The genus *Calyptrobothrium*, established by Monticelli<sup>a</sup> belongs to the family Tetrabothriidae and is near the genus *Monorygma*.

The scolex is provided with four flexible unarmed bothria and each bothrium with a single large horseshoe-shaped sucker.

In 1899<sup>b</sup> I described a species of *Calyptrobothrium* under the name *C. occidentale*. This description was based on one large and eight small specimens collected from the torpedo (*Tetranarce occidentalis*). No mature segments were found, and, although the large specimen was regarded by me at the time of collecting as a different species from the small specimens, a study of the preserved material did not appear to justify placing them in distinct species.

During the summer of 1905, I had the opportunity of examining a considerable number of these cestodes, and, finding the two kinds, in some cases associated together, in others separate, moreover with ripe segments, which were proved to belong to the small variety, it became evident that the two sizes represented different species.

The name *Calyptrobothrium occidentale* is retained for the larger variety of the original description and the name *C. minus* is proposed for the smaller variety.

The following account is based on material collected at the laboratory of the Bureau of Fisheries, Woods Hole, Massachusetts, in July and August, 1905. The torpedoes were taken at Menemsha Bight, Vineyard Sound. Some of them were brought to Woods Hole alive; others were opened when taken and the viscera placed in formalin.

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<sup>a</sup>Naturalista Siciliano, An. xii, 1893, p. 15 of Author's separate, pl. 1, figs. 1-4.

<sup>b</sup>Bull. U. S. Fish. Comm. for 1899, p. 298.

## Summary of collections made in 1905.

Date.	Number of hosts.	Condition of material.	<i>C. occidentale</i> .	<i>C. minus</i> .	Food notes.
July 21.....	1	In formalin.....	.....	.....	Empty.
July 27.....	1	do.....	.....	100	Pebbles.
August 4.....	1	Living.....	.....	Many.	Empty.
August 7.....	1	do.....	7	55	Do.
August 8.....	1	In formalin.....	2	.....	Do.
August 9.....	1	Living.....	.....	20	Do.
August 10.....	1	In formalin.....	2	Few.	Do.
August 12.....	2	Living.....	Few in one host only.	12 in each.	Amphipod and otolith of squetague.
August 17.....	1	In formalin.....	.....	17	Empty.
August 18.....	1	do.....	Few.	Few.	Do.
August 18.....	1	do.....	4	.....	Otoliths of fish.
August 19.....	1	do.....	1	.....	Empty.
August 22.....	1	do.....	Few.	Few.	Do.
August 26.....	1	Living.....	.....	8	Do.

## CALYPTROBOTHRIUM OCCIDENTALE Linton.

*Calyptribothrium occidentale* LINTON, (part) Bull. U. S. Fish Comm. 1899, pp. 298-299, pl. XII, figs. 94, 95, 97.

Head with thickened axial portion, bluntly rounded in front; bothria four, in pairs, the anterior end of each a relatively large horseshoe-shaped sucker, and sessile, the posterior end auriculate and free. Neck continuous with axial portion of head, retaining dimensions of head, exclusive of bothria, for a short distance, then diminishing slightly. Entire strobile nearly linear; segments begin remote from head, at first much shorter than broad, later becoming squarish, finally nearly circular and separating easily; free segments usually a little longer than broad, with rounded extremities; none certainly seen with ripe ova.



FIG. 1.—CALYPTROBOTHRIUM OCCIDENTALE. SCOLEX; SKETCH MADE FROM SPECIMEN IN GLYCERIN. ACTUAL DIAMETER OF HEAD 1.35 MM.

Neck and body crossed by minute transverse lines which make a serrate outline on the margins.

Length often as much as 250 mm., breadth 2 mm. In a mounted specimen the diameter of the head is 1.35 mm., and the breadth of the neck 1.12 mm.

Considerable variation was noted in anatomical details of the several segments which were examined, but the general plan is much like that shown in the segment sketched in fig. 2. The genital cloacae are irregularly alternate and are on the lateral margin near the middle of the length of the segments. The cirrus lies posterior to the vagina

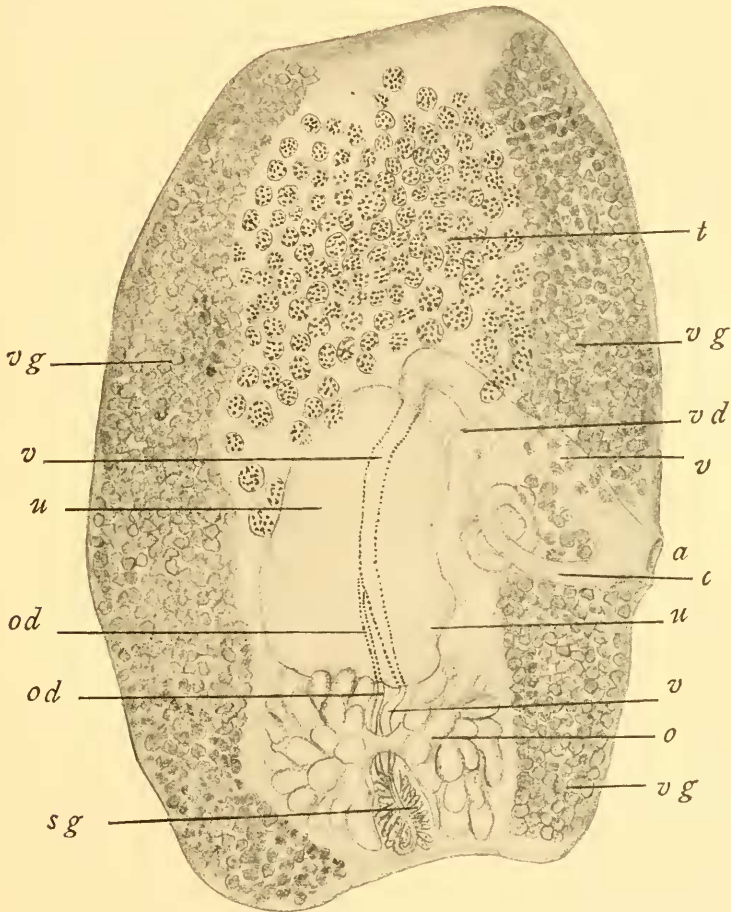


FIG. 2.—CALYPTROBOTHRIUM OCCIDENTALE. FREE SEGMENT; SKETCH MADE FROM SPECIMEN, STAINED AND MOUNTED IN BALSAM. ACTUAL LENGTH 2.5 MM. *a*, GENITAL CLOACA; *c*, CIRRUS; *o*, OVARY; *o. d.*, OVIDUCT; *s. g.*, SHELL GLAND; *t*, TESTES; *u*, UTERUS; *v*, VAGINA; *v. d.*, VAS DEFERENS; *v. g.*, VITELLINE GLAND.

and is relatively long and spinose. It was not seen everted in this species, but it appears to agree closely with the same organ in *C. minus*.

The testes are globular, numerous, and lie in the anterior half of the segment along a median space equal to rather more than one-third of the breadth of the segment.

In front of the cirrus pouch, and at first parallel with it, the vagina extends anteriorly from the genital cloaca to about the median line of the segment, thence back toward the posterior end. Behind the uterus it becomes slightly convoluted, passes toward the opposite face between the two lateral ovarian masses, where it was observed in some cases to expand into a seminal receptacle. It appears to receive a short duct from the ovary—then the common duct passes to one side of the shell gland, which it enters at the posterior end. Just before entering the shell gland the common duct appears to be joined by ducts from the vitellaria. The shell gland lies between the posterior extremities of the two lateral ovarian masses.

From the anterior end of the shell gland the slender oviduct passes anteriorly, lying close beside the vagina, to open into the spacious uterus at about the middle of the length of the latter organ. The uterus lies between the anterior end of the ovary and the angle of the vagina and its breadth in the maturest segments seen was equal to nearly one-third the breadth of the segment. No ripe ova were seen in any segments which were certainly from strobiles of this species. In a few cases small spherical bodies were seen in the uterus which appeared to be unfertilized cells from the germarium. The ovary lies near the posterior end of the segment, and consists of two lateral masses on either side of the median line, each of which is made up of a number of small lobes. The vitellaria lie along the lateral margins from one end of the segment to the other. Vitelline ducts were distinguished, but their exact place of union with the duct leading from the seminal receptacle to the shell gland was not seen either in sections or in entire segments.

NOTES ON *C. OCCIDENTALE* MADE AT THE TIME OF COLLECTING.

*August 7.*—Of the 7 scoleces with strobiles the longest was 216 mm., the shortest 30 mm. Aggregate length 1,400 mm., average 200 mm. Many free segments were found, also many still attached to the strobiles which separated easily from the chain. Most of these were nearly circular in outline, with the diameter 1.5 mm.; a few were slightly longer than broad, length 2 mm., breadth 1.5 mm. These measurements were made on specimens killed in 70 per cent alcohol, in which they shrink but very little. This is in marked contrast with the behavior of the smaller form, *C. minus*, which contracts very much when placed in alcohol.

*August 10.*—Length of strobiles, in formalin, 100 and 140 mm.

*August 12.*—Several were found in one only of the two torpedoes. There were many free segments, some of which evidently belonged to *C. minus*. In my notes I record the finding of fusiform ova in some of the segments which I referred to *C. occidentale*. I have since examined a number of these segments but have failed to find ova in any segments which I could with certainty refer to this species.

An abnormal segment was found in this lot which I have made the subject of a special paper.<sup>a</sup>

This is a case of reduplication and reversal of parts. There are two complete sets of genital organs. The two cloacal apertures are on the same lateral margin. The ovaries are at opposite ends and the testes make a central mass common to both components. The double segment is 4 mm. in length and 2 mm. in breadth.

In this lot some of the strobiles contracted in a remarkable fashion, so as to resemble specimens of turning as seen in table legs and the like.

August 18.—Material in formalin. One small specimen had contracted so as to resemble the large form. The free segments resembled *C. minus*, the scolex and fragments resembled *C. occidentale*. It was the occurrence of phenomena like these, observed in the single lot of specimens upon which the original description of the species was based, which led me to regard the two forms as varieties of the same species.

August 18.—Material in formalin. The four specimens were in poor condition; one was quite flaccid and measured 410 mm. in length.

August 19.—The single large specimen was of a faint pink color.

August 22.—Several fragments were found, but no free segments. One small specimen with thick neck, apparently a young scolex of this species.

#### CALYPTROBOTHRIUM MINUS, new species.

*Calyptrobthrium occidentale* LINTON (part), Bull. U. S. Fish Comm. for 1899, pp. 298-299, pl. XL1, figs. 92, 93, 96.

Head truncate, axial portion not conspicuously thickened; bothria in pairs, prominent, very flexible in life, the anterior ends with the relatively large sucker characteristic of the genus, the posterior ends slender and tapering. Neck slender, much smaller than head, with

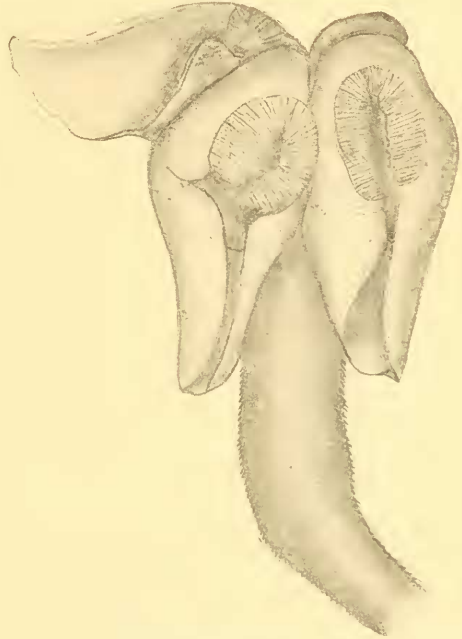


FIG. 3.—CALYPTROBOTHRIUM MINUS. SCOLEX; SKETCH MADE FROM SPECIMEN MOUNTED IN BALSAM. ACTUAL DIAMETER OF NECK 0.222 MM.

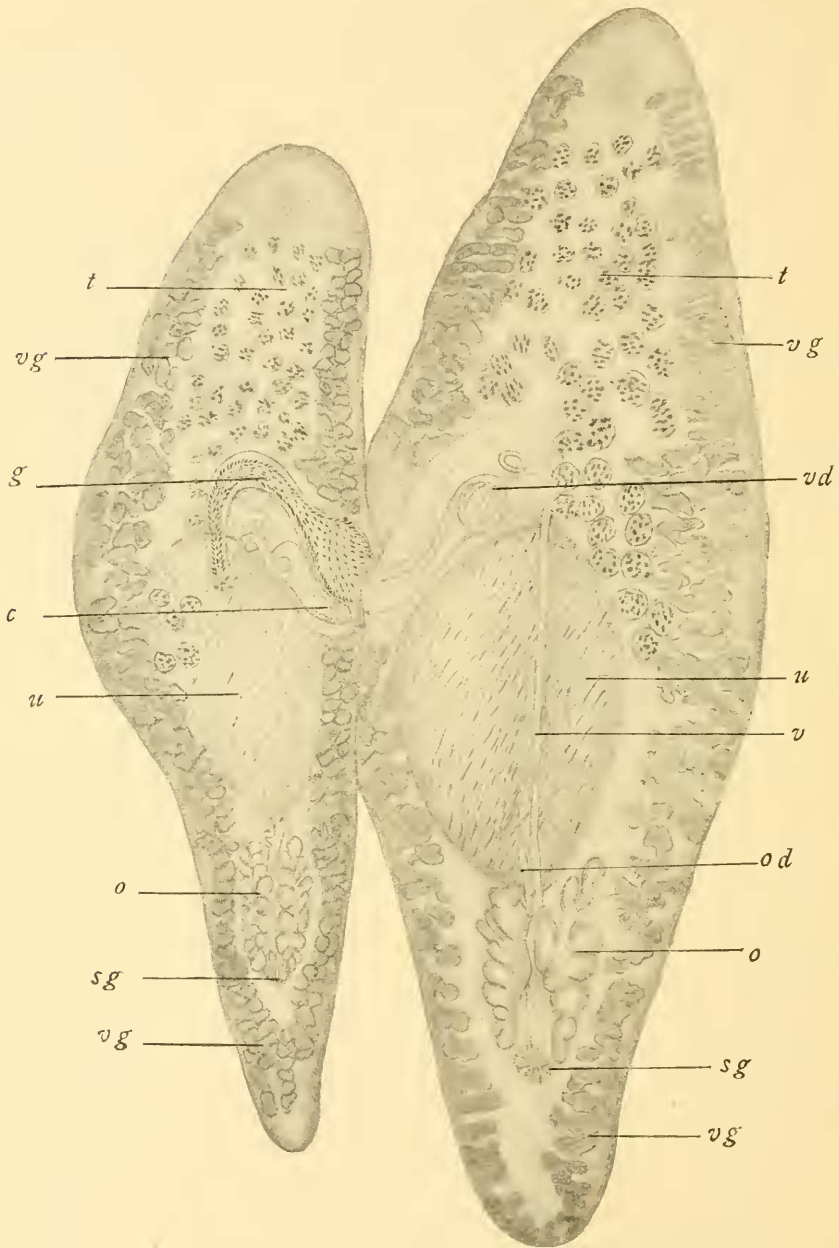


FIG. 4.—*CALYPTROBOTHRIUM MINUS*. FREE SEGMENTS IN COITU; SKETCHED FROM SPECIMEN STAINED AND MOUNTED IN BALSAM. ACTUAL LENGTH OF LARGER SEGMENT 4.88 MM. *c*, CIRRUS OF SMALLER SEGMENT RETRACTED; *g*, CIRRUS OF LARGER SEGMENT EVERTED AND INSERTED IN VAGINA OF SMALLER SEGMENT; *u*, UTERUS FILLED WITH FUSIFORM OVA. FOR EXPLANATION OF OTHER LETTERS SEE FIG. 2.

conspicuous serrate outlines. The segments begin remote from the head, at first much broader than long, later becoming squarish, then longer than broad, ultimately pointed at both extremities, but particu-

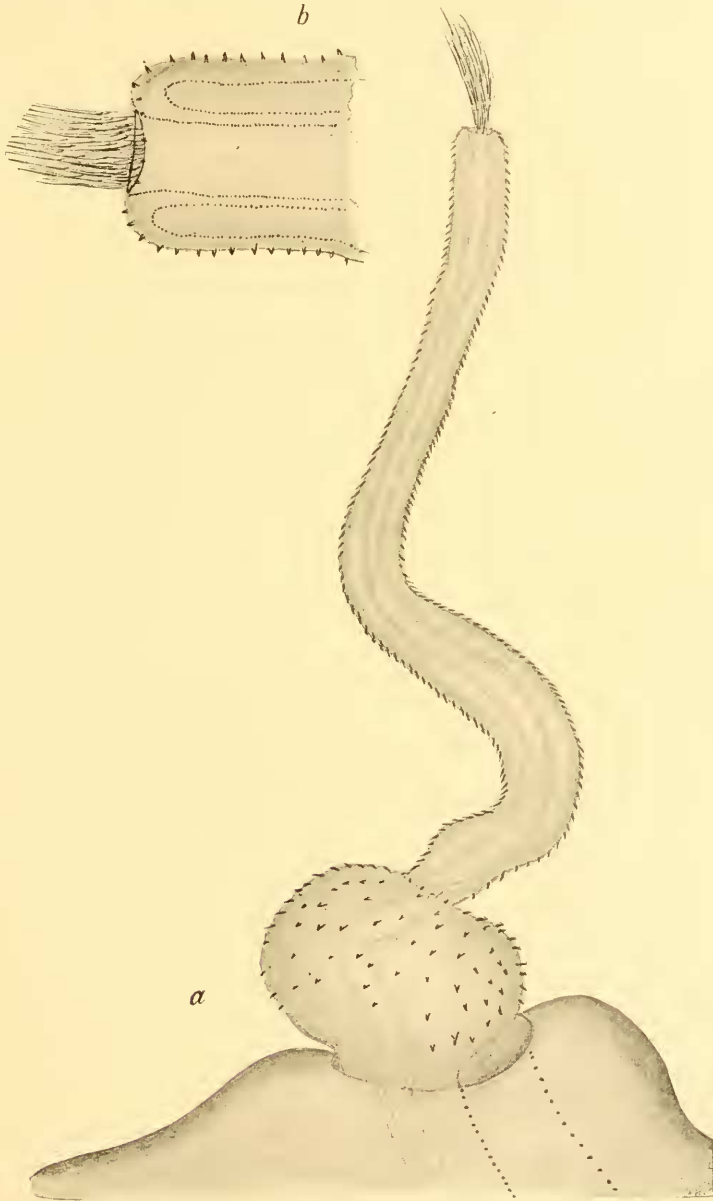


FIG. 5.—CALYPTROBOTHRIUM MINUS. *a*, CIRRUS EVERTED; *b*, DISTAL END OF SAME, MORE HIGHLY MAGNIFIED; SKETCHED FROM SPECIMEN IN SEA WATER FIXED OVER FLAME. SPERMATOZA ARE SEEN ISSUING FROM APEX. ACTUAL DIAMETER OF BASAL BULB 0.3 MM., AT DISTAL END 0.06 MM.

larly at the posterior extremity. Free, ripe segments, considerably larger, flattened, fusiform, with a mass of fusiform ova in the uterus.

The entire strobile has a tendency to become fusiform when placed in the killing fluid, in which it contracts strongly.

The general plan of the anatomy of a mature segment is like that of *C. occidentale*. The vitellaria are proportionately less voluminous and the lobes of the testes are, perhaps, relatively larger. The cirrus, which was seen everted, is provided with a basal bulb and is spinose. The shell gland is placed a little farther back in relation to the ovary than in *C. occidentale*, although this may be a character incident to the greater maturity of the segments.

Maximum length 50 mm., breadth 0.5 mm.

Diameter of head of mounted specimen 0.6 mm., of neck 0.22 mm.

NOTES ON *C. MINUS*, MADE AT THE TIME OF COLLECTING.

*July 27.*—Approximately 100 specimens were taken from a spiral valve, which had been lying for two days in 5 per cent formalin.

While collecting these specimens from a dish of sea water in which the material had been washed, a living scolex was found by Mr. Carl D. Sawyer. The specimen was, without doubt, alive, and it remained living and active for some minutes after my attention was called to it. Fig. 7 is from a sketch made of this scolex after it had come to rest. No other living specimens were found in the dish. The length of a single bothrium at rest was 0.7 mm. I can not account for the presence of this living scolex in the dish. It seems to me incredible that it came from the intestine of the torpedo, which had been in a jar of 5 per cent formalin for two days.

*August 4.*—Many were found in the spiral valve. The heads, as usual with this species, were, for the most part, firmly embedded in the mucous membrane of the host. Unless care is taken the heads may very easily be lost. Many mature, free segments were found in this lot, with the mass of ova showing as a dark brown spot. The mature segments evidently increase in size after separating from the strobile. The posterior segments of the strobile separate easily while they are still much smaller than the ripe segments.

The posterior portion of a strobile with maturing segments is usually moniliform. The last segment is often tapering at its posterior end. There is some variation in the size of the fusiform ova; the largest were about 0.17 mm. in length and 0.017 mm. in diameter.



FIG. 6.—CALYPTROBOTHRIUM MINUS. OVA; SKETCHED FROM LIFE. ACTUAL LENGTH OF ONE 0.16 MM., DIAMETER 0.02 MM.



One strobile, which measured 42 mm. in sea water shrank to 24 mm. in 70 per cent alcohol, and another shrank from 50 mm. to 30 mm.

*August 7.*—This torpedo was taken at Menemsha Bight on August 3, and kept in the aquarium until the 6th, when the spiral valve was removed and kept on ice until the 7th. The tapeworms were found to be still alive and remained moderately active for some time in sea water. Placed in 70 per cent alcohol they contracted strongly, for example, from 30 mm. to 20 mm. and from 55 mm. to 30 mm.

*August 7.*—No scoleces nor strobiles were obtained, but a few minute, active bodies were found in the spiral valve which looked like very small specimens of *Scolex polymorphus*



FIG. 8.—CALYPTROBOTHRIUM MINUS. FRAGMENT OF STROBILE, YOUNG; SKETCHED FROM LIFE. ACTUAL LENGTH 0.8 MM.; BREADTH 0.28 MM.



FIG. 7.—CALYPTROBOTHRIUM MINUS. YOUNG SCOLEX; SKETCH MADE FROM LIFE. ACTUAL LENGTH OF BOTHRIMUM 0.7 MM.

until they were examined with a lens (fig. 8). Upon being magnified they were seen to be fragments of the young of this species. The anterior end for

not quite half the length was armed with minute bristles; the posterior end, for a little more than half the length, with minute serrations. The length was about 0.8 mm., the breadth 0.28 mm. One was seen with the rudiments of reproductive organs.

*August 9.*—Free, ripe segments were found with this lot.

*August 10.*—A large number of ripe segments were found in this lot.

*August 12.*—About 12 strobiles of this species were found in each of the two torpedoes with an enormous number of free and ripe segments. The latter were most abundant in the torpedo in which none of the larger species (*C. occidentale*) were found. The free segments are capable of making progressive

movements, during which the anterior end is elongated so as to resemble the neck of certain distomes. The resemblance is heightened by the almost constant presence of a rounded knob at the anterior end. The surface of the joint is slightly roughened by very minute serrations which project posteriorly, so that the spasmodic contractions of the body, aided by a kind of flowing peristalsis, constantly propel the segment forward. I did not observe the anterior end acting as a sucker.

*August 17.*—About 17 strobiles of this species and two small nematodes were obtained from the torpedo which was examined on this date.

*August 18.*—One of the torpedoes had a few free segments which resembled this species; the other had eight strobiles, which, however, were not in good condition.

*August 22.*—A few of each species were found, but no free segments.

*August 26.*—About eight scoleces were taken from a torpedo which had been kept in the aquarium over two weeks and had died on the evening of the 25th. The worms, which were very slender, were still active. No ripe segments were found.